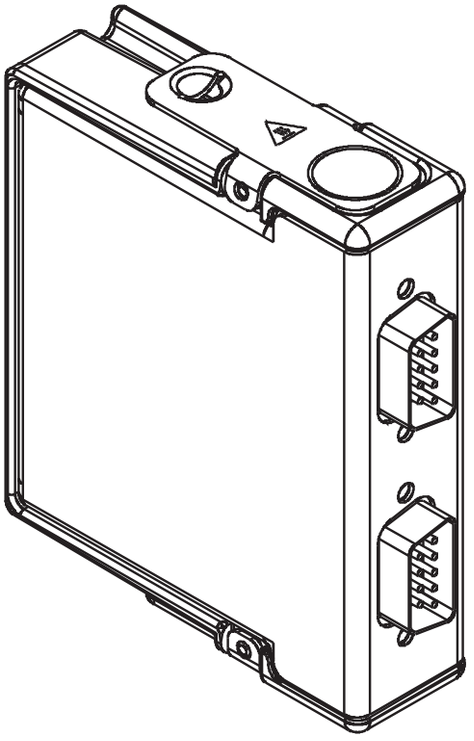
OPERATING INSTRUCTIONS

NI 9853

2-Port, High-Speed CAN Module



NATIONAL INSTRUMENTS™

These operating instructions describe how to use the National Instruments (NI) 9853 module. For information about installing, configuring, and programming your system, refer to your system documentation. The NI 9853 module requires the NI 9853 software to be installed. The latest version of the NI 9853 software is located at `ni.com/downloads`.

Note The safety guidelines and specifications in this document are specific to the NI 9853. The other components in your system may not meet the same safety ratings and specifications. Refer to the documentation for each component in your system to determine the safety ratings and specifications for the entire system.

Safety Guidelines

Operate the NI 9853 only as described in these operating instructions.

Hot Surface This icon denotes that the component may be hot. Touching this component may result in bodily injury.

Safety Guidelines for Hazardous Locations

The NI 9853 is suitable for use in Class I, Division 2, Groups A, B, C, D, T4 hazardous locations; Class I, Zone 2, AEx nA II T4 and Ex nA II T4 hazardous locations; and nonhazardous locations only. Follow these guidelines if you are installing the NI 9853 in a potentially explosive environment. Not following these guidelines may result in serious injury or death.

Caution Do *not* disconnect I/O-side wires or connectors unless power has been switched off or the area is known to be nonhazardous.

Caution Do *not* remove modules unless power has been switched off or the area is known to be nonhazardous.

Caution Substitution of components may impair suitability for Class I, Division 2.

Caution For Zone 2 applications, install the CompactRIO system in an enclosure rated to at least IP 54 as defined by IEC 60529 and EN 60529.

Caution For Zone 2 applications, install a protection device between the CAN signals and the NI 9853 CAN pins. The device must prevent the CAN Port-to-COM voltage from exceeding 55 V if there is a transient overvoltage condition.

Special Conditions for Safe Use in Europe

This equipment has been evaluated as EEx nA II T4 equipment under DEMKO Certificate No. 03 ATEX 0324020X. Each module is marked ⟨Ex⟩ II 3G and is suitable for use in Zone 2 hazardous locations.

Wiring the NI 9853

The NI 9853 has two 9-pin male D-Sub connectors that provide connections to a CAN bus. Each port on the NI 9853 has pins for CAN_H and CAN_L, to which you connect the CAN bus signals. These signals should be connected using twisted-pair cable.

Each port has two common pins (COM) that are internally connected to the isolated reference of the module and serve as the reference ground for CAN_H and CAN_L. You can connect the CAN bus reference ground (sometimes referred to as CAN_V–) to

one or both of the COM pins. Each port also has an optional shield pin, SHLD, that can be connected to a shielded CAN cable. Connecting SHLD may improve signal integrity and EMC performance in a noisy environment.

CAN0 of the NI 9853 is internally powered, and therefore requires no external power supply. CAN1 requires an external power supply of +8 to +25 V to operate. Supply power to the V_{SUP} pin of CAN1 from the CAN bus.

Note Although CAN0 of the NI 9853 does not require an external power supply to operate, it can be connected to a powered CAN bus without being damaged.

Pinouts for CAN0 and CAN1 of the NI 9853 are listed in Table 1 and Table 2.

Table 4 lists recommended termination resistor values.

Table 1. Pin Assignments for CAN0

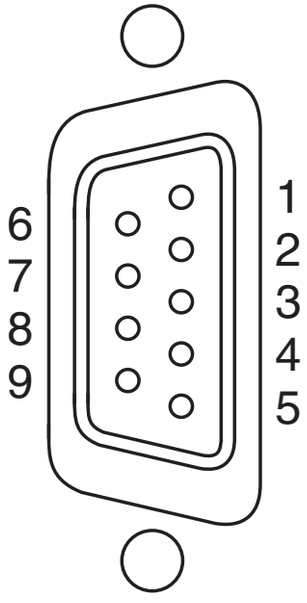
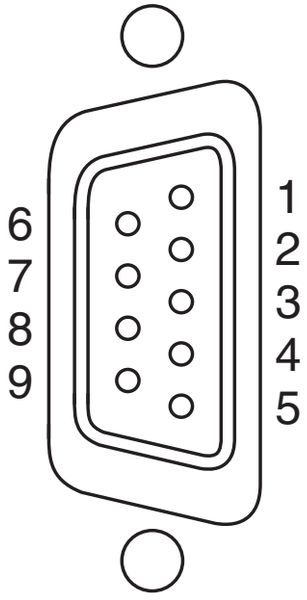
Connector	Pin	Signal
	1	No Connection (NC)
	2	CAN_L
	3	COM
	4	NC
	5	SHLD
	6	COM
	7	CAN_H
	8	NC
	9	NC

Table 2. Pin Assignments for CAN1

Connector	Pin	Signal
	1	No Connection (NC)
	2	CAN_L
	3	COM
	4	NC
	5	SHLD
	6	COM
	7	CAN_H
	8	NC
	9	V_{SUP}

CAN Bus Topology and Termination

A CAN bus consists of two or more CAN nodes cabled together. The CAN_H and CAN_L pins of each node are connected to the main CAN bus cable through a short connection known as a “stub.” The pair of signal wires, CAN_H and CAN_L constitutes a transmission line. If the transmission line is not terminated, each signal change on the bus causes reflections that may cause communication errors. Because the CAN bus is bidirectional, both ends of the cable must be terminated. However, this requirement does not mean that every node on the bus should have a termination resistor—only the nodes at the end of the cable should have termination resistors.

Figure 1 shows a simplified diagram of a CAN bus with multiple CAN nodes, and proper termination resistor (R_t) locations.

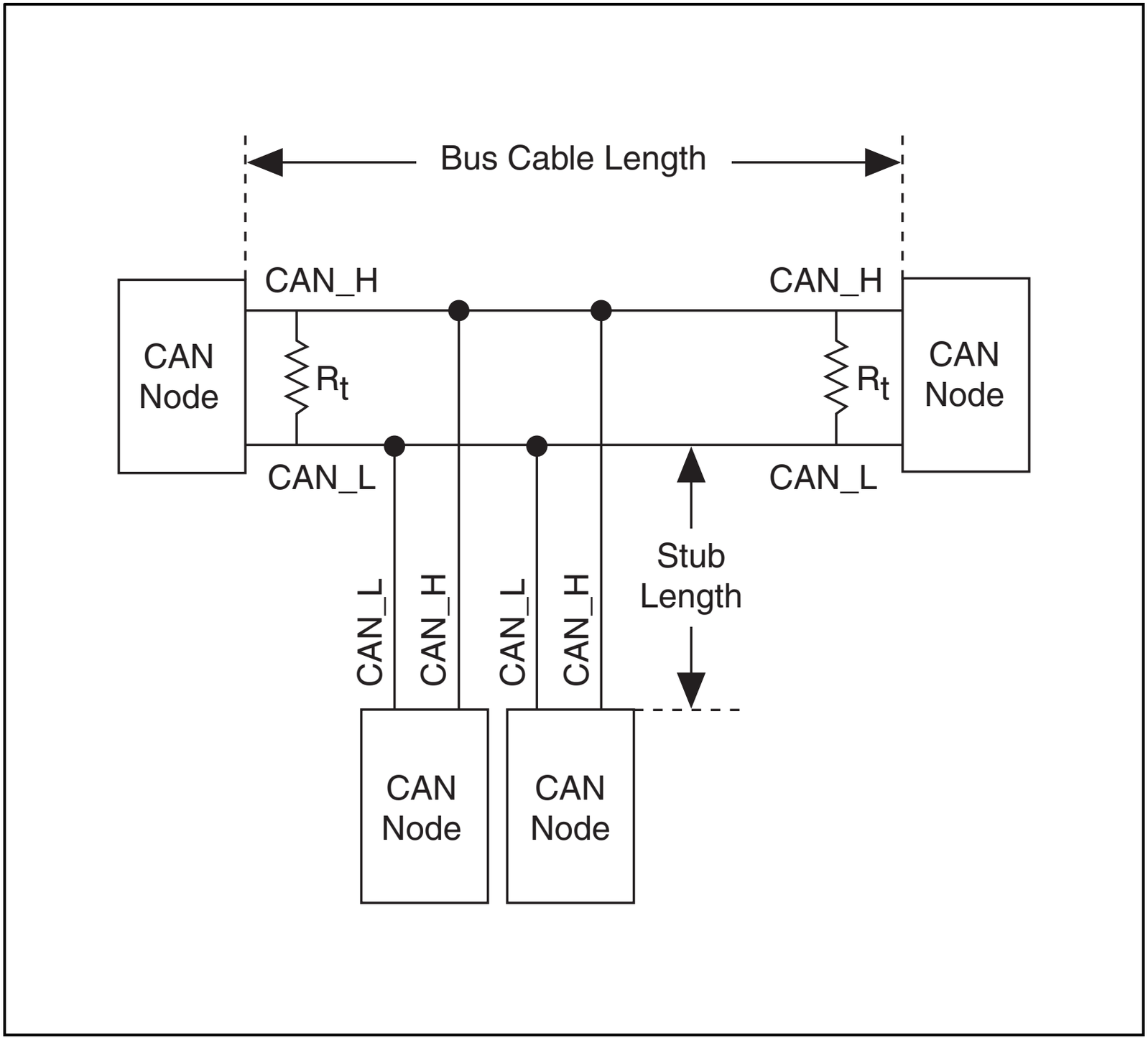


Figure 1. CAN Bus Topology and Termination Resistor Locations

Connecting a CAN Bus to the NI 9853

Each port of the NI 9853 can be connected to any location on a CAN bus. Figure 2 shows one example of the connection of CAN0 of the NI 9853 directly to one CAN node, and CAN1 directly to another CAN node. CAN1 requires an external power supply on the CAN bus.

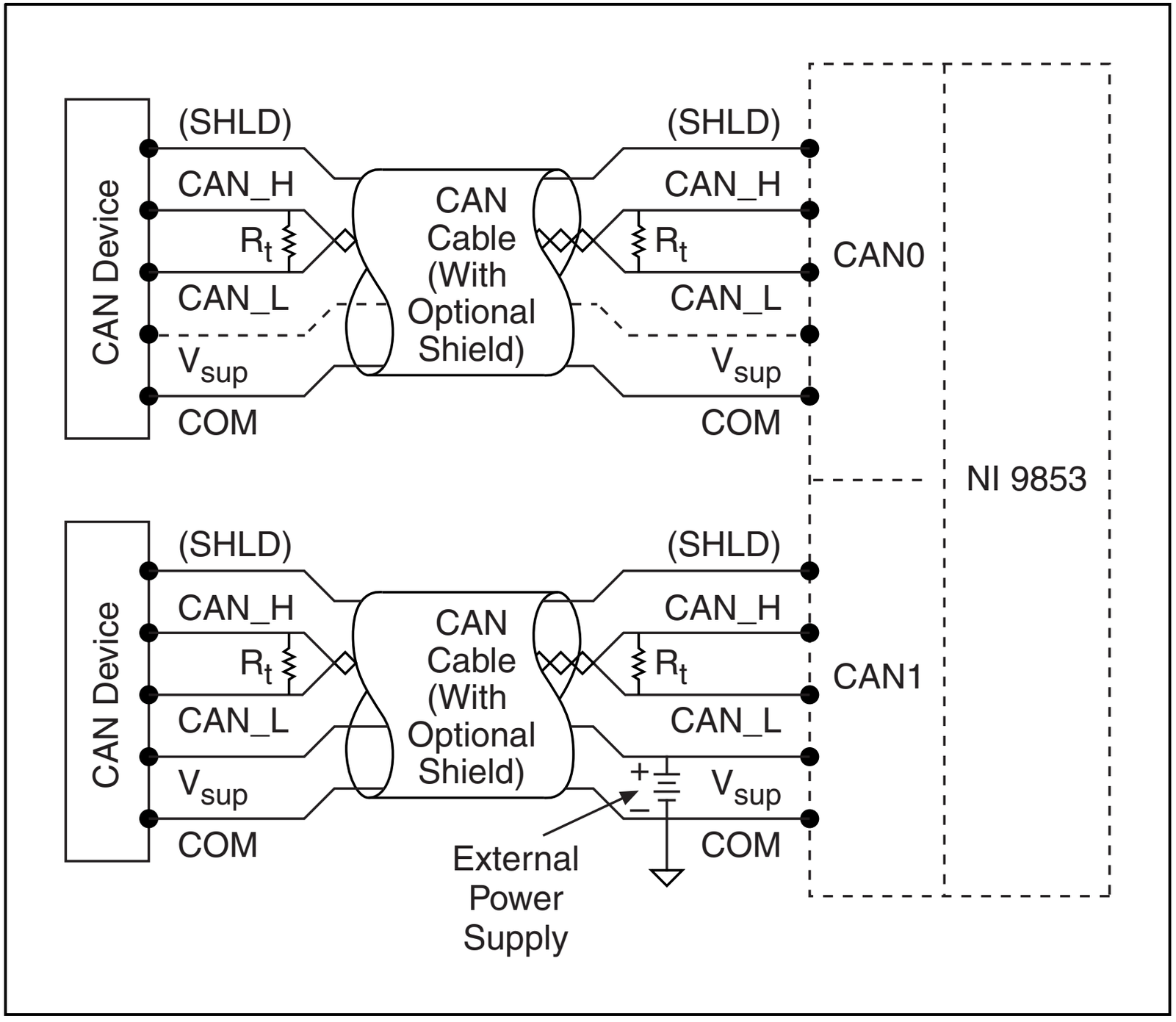


Figure 2. Connecting Both Ports of the NI 9853 to CAN Buses

Cabling Requirements for NI 9853

This section deals with cabling specifications, termination resistors, cable lengths, and the number of CAN nodes that can exist in a system.

Cable Specifications

Cables should meet the physical medium requirements specified in ISO 11898, shown in Table 3. Belden cable (3084A) meets all of those requirements, and should be suitable for most applications.

Table 3. ISO 11898 Specifications for Characteristics of a CAN_H and CAN_L Pair of Wires

Characteristic	Value
Impedance	95 Ω minimum, 120 Ω nominal, 140 Ω maximum
Length-related resistance	70 mΩ/m nominal
Specific line delay	5 ns/m nominal

Termination Resistors

The termination resistors (R_t) should match the nominal impedance of the CAN cable, and therefore comply with the values in Table 4.

Table 4. Termination Resistor Specification

Characteristic	Value	Condition
Termination resistor, R_t	100 Ω min, 120 Ω nominal, 130 Ω max	Minimum power dissipation: 220 mW

Cable Lengths

The allowable cable length is affected by the characteristics of the cabling and the desired bit transmission rates. Detailed cable length recommendations can be found in the ISO 11898, CiA DS 102, and DeviceNet specifications.

ISO 11898 specifies 40 m total cable length with a maximum stub length of 0.3 m for a bit rate of 1 Mb/s. The ISO 11898 specification says that significantly longer cable lengths may be allowed at lower bit rates, but each node should be analyzed for signal integrity problems.

Number of CAN Nodes

The maximum number of nodes depends on the electrical characteristics of the nodes on the network. If all of the nodes meet the requirements of ISO 11898, at least 30 nodes may be connected to the bus. Higher numbers of nodes may be connected if the electrical characteristics of the nodes do not degrade signal quality below ISO 11898 signal level specifications.

The electrical characteristics of the NI 9853 allow at least 110 CAN ports on a network.

NI 9853 Hardware Overview

The NI 9853 has two full-featured, independent CAN ports that are isolated from each other, and from the other modules in the system. Each port of the NI 9853 has a Philips SJA1000 CAN controller that is CAN 2.0B-compatible and fully supports both 11-bit and 29-bit identifiers. Each port also has a Philips TJA1041 High-Speed CAN transceiver that is fully compatible with the ISO 11898 standard and supports baud rates up to 1 Mbps.

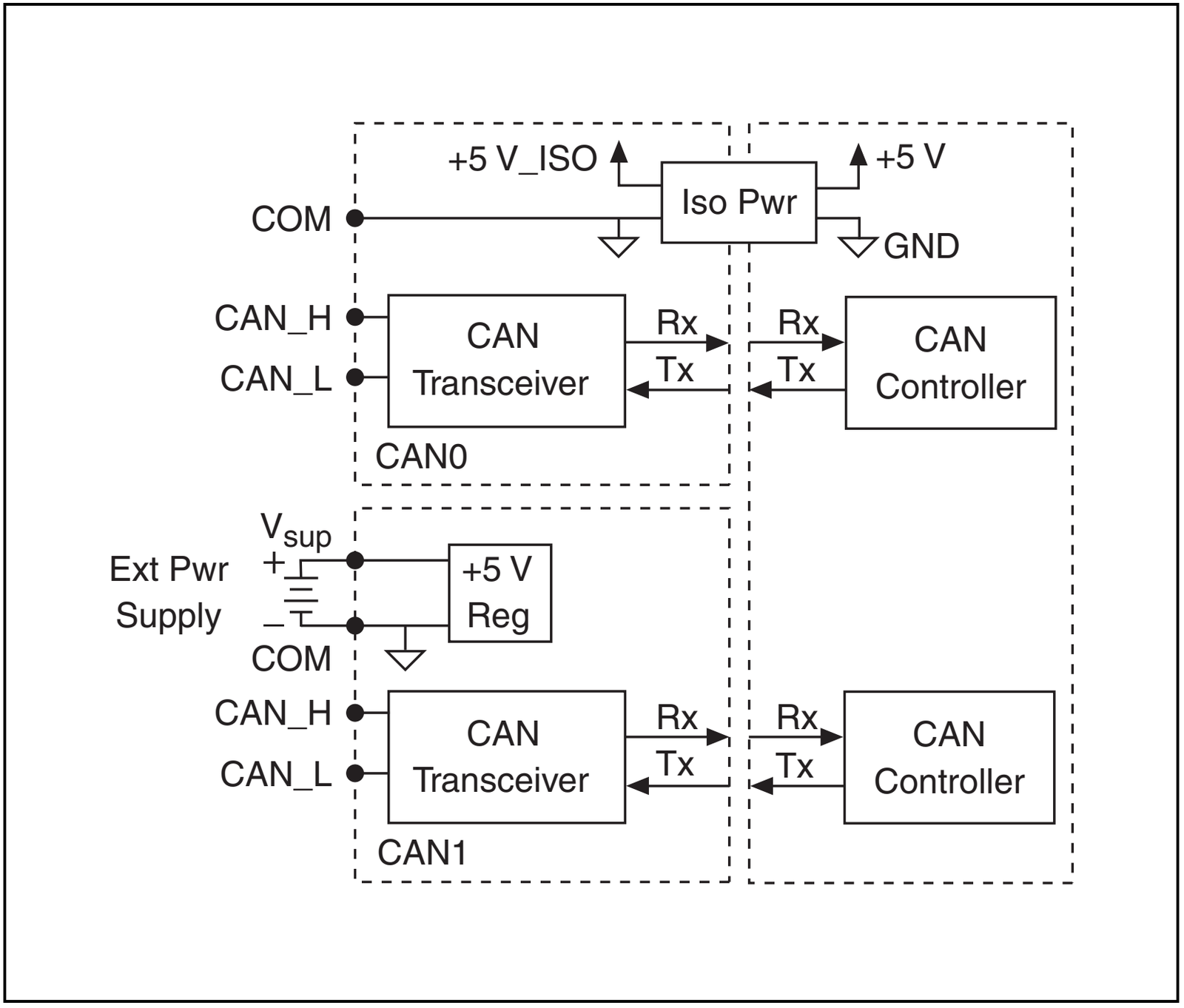


Figure 3. NI 9853 Hardware Overview

Sleep Mode (CompactRIO Only)

You can enable sleep mode for the CompactRIO system in software. In sleep mode, the system consumes less power and may dissipate less heat. Typically, when a system is in sleep mode, you cannot communicate with the modules. Refer to the *Specifications* section for more information about power consumption and thermal dissipation.

This system sleep mode should not be confused with the NI 9853 Transceiver Mode Sleep property, which sets only the CAN port to sleep mode. Refer to the FPGA Module topic in *LabVIEW Help* for more information on the Transceiver Mode property.

Specifications

The following specifications are typical for the range –40 to 70 °C unless otherwise noted.

High-Speed CAN Characteristics

Transceiver..... Philips TJA1041

Max baud rate ..... 1 Mbps

CAN_H, CAN_L bus lines voltage..... –27 to +40 VDC

Supply voltage range (V_{SUP})

CAN0 ..... N/A

CAN1 ..... +8 to +25 VDC

MTBF ..... 1,816,913 hours at 25 °C; Bellcore Issue 6, Method 1, Case 3, Limited Part Stress Method

Note Contact NI for Bellcore MTBF specifications at other temperatures or for MIL-HDBK-217F specifications.

Power Requirements

Power consumption from chassis

- Active mode
  - Transmitting ..... 625 mW max
  - Receiving ..... 400 mW max
- Sleep mode ..... 25 µW max

Thermal dissipation (at 70 °C)

- Active mode ..... 1 W max
- Sleep mode ..... 250 mW max

Physical Characteristics

If you need to clean the module, wipe it with a dry towel.

Weight ..... Approx. 144 g (5.0 oz)

Safety

Maximum Voltage[1]

Connect only voltages that are within these limits.

Port-to-COM.....–27 to +40 VDC max,
Measurement Category I

Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as *MAINS* voltage. MAINS is a hazardous live electrical supply system that powers equipment. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.

Caution Do not connect to signals or use for measurements within Measurement Categories II, III, or IV.

---

[1] The maximum voltage that can be applied or output between any port or V_{SUP} terminal and a COM terminal without creating a safety hazard.

Isolation Voltages

Port-to-port

Continuous ..... 60 VDC, Measurement Category I up to 5,000 m altitude

Withstand..... 500 V_{rms}, verified by a 5 s dielectric withstand test

Port-to-earth ground

Continuous ..... 60 VDC, Measurement Category I up to 5,000 m altitude

Withstand..... 500 V_{rms}, verified by a 5 s dielectric withstand test

Safety Standards

The NI 9853 is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

Note For UL and other safety certifications, refer to the product label, or visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Hazardous Locations

U.S. (UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nA II T4
Canada (C-UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nA II T4
Europe (DEMKO)	EEx nA II T4

Environmental

Refer to the installation instructions for the chassis you are using for more information about meeting these specifications.

Operating temperature ..... –40 to 70 °C

Storage temperature ..... –40 to 85 °C

Ingress protection..... IP 40

Operating humidity ..... 10 to 90% RH, noncondensing

Storage humidity..... 5 to 95% RH, noncondensing

Pollution Degree (IEC 60664) 2

Maximum altitude..... 5,000 m

Indoor use only

Shock and Vibration

To meet these specifications, you must panel mount the CompactRIO system.

Operating vibration, random (IEC 60068-2-64) ..... 5 g_{rms}, 10 to 500 Hz

Operating shock
(IEC 60068-2-27)..... 30 g, 11 ms half sine,
50 g, 3 ms half sine,
18 shocks at 6 orientations

Operating vibration,
sinusoidal (IEC 60068-2-6) ..... 5 g, 10 to 500 Hz

Electromagnetic Compatibility

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326 EMC requirements; Minimum Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

Note For EMC compliance, operate this device with shielded cabling.

CE Compliance CE

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at ni.com/environment. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment, visit ni.com/environment/weee.htm.

电子信息产品污染控制管理办法 （中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china。 (For information about China RoHS compliance, go to ni.com/environment/rohs_china.)

National Instruments Contact Information

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your service request at `ni.com/support` and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, visit the Worldwide Offices section of `ni.com/niglobal` to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

LabVIEW, National Instruments, NI, ni.com, the National Instruments corporate logo, and the Eagle logo are trademarks of National Instruments Corporation. Refer to the *Trademark Information* at `ni.com/trademarks` for other National Instruments trademarks. Other product and company names mentioned herein are trademarks or trade names of their respective companies. For patents covering National Instruments products/technology, refer to the appropriate location: **Help»Patents** in your software, the `patents.txt` file on your media, or the *National Instruments Patent Notice* at `ni.com/patents`.

© 2006–2011 National Instruments Corp. All rights reserved.

371453E-01 Jan11